RESEARCH ARTICLE

Effectiveness of low-level diode laser compared to desensitizing agent in treatment of post scaling dentine hypersensitivity

Sarah A. Abed,[a] Reem F. Abbas,[b] Rusul A. Jasim,[c] Bassam S. Abdulhameed,[d] Lina E. Khalid,[e] Abeer I. Abdulhameed,[f] Zainab Q. Mohammed,[g] Bushra Z. Shaban,[h] Farah Q. Shayea.[i]

ABSTRACT

Introduction: Dentine hypersensitivity (DH) is considered a common and noxious side effect for patients after periodontal instrumentation. Low-level laser therapy (LLLT) using diode laser and desensitizing agents can be an effective treatment modality for dentine hypersensitivity.

Objective: This study compared the effects of low-level diode laser therapy to a Riva star (SDI) desensitizing agent on post-scaling dentine hypersensitivity.

Methods: We enrolled 60 patients indicated for scaling and polishing with calculus build-up having at least 2 mm gingival recession, so supposed to have exposed root surface and dentine hypersensitivity (DH) after non-surgical periodontal treatment (NSPT). After treatment, randomly allocated in one of three groups: control group, patients experience pain during periodontal scaling procedure receiving scaling and polishing only. Study group 1: patients experience pain during the periodontal scaling procedure receiving scaling and polishing with a desensitizing agent on the exposed root surface. Study group 2: patients experienced pain during the periodontal scaling procedure receiving scaling and polishing with the application of with low-level diode laser therapy (quick lase QWLASER3-8(810nm)) on the exposed root surface, and a negative group were applied to patients who did not feel any pain during the periodontal scaling procedure, after two days the patients were asked about the occurrences of dentine hypersensitivity using a visual analogue scale (VAS).

Results: There were statistically significant differences between the different groups of the study, between control and study group 1, between control and study group 2, and between the two study groups.

Conclusion: Both low-level diode laser therapy (LLLT) and desensitizing agents can effectively reduce the post-scaling dentine hypersensitivity that may be associated with periodontal instrumentation, with better results for diode laser.

Key words: Post-scaling dentine hypersensitivity, Low-level diode laser, Densitizing agent.

INTRODUCTION

Periodontal disease therapy involves lowering the microbial biofilm present in the supragingival and subgingival areas of the teeth and providing the patient with instructions to assist in minimizing the risk factors that contribute to the advancement of the illness. [1,2]

Gingival tissues frequently recede following non-surgical periodontal treatment (NSPT).[3] The root surface is left subjected to the oral environment. Gingival tissues frequently recede following NSPT, resulting in an iatrogenic exposure of root dentin that results from extensive cement layer removal, producing post-operative complications, including dentin hypersensitivity (DH).[4,5]

Clinical trials have tested several desensitizing medications on sensitive dentin

a: Msc, Periodontist. *b-c :* BDS., HDD, Periodontist. *d-e:* Msc, Periodontist. *f-h:* BDS., HDD, Periodontist. *i:* DM ,Dental hygieist. All are working at Al-Sheikh Omar Dental Health Specelized Centre. Al-Rasafa Health Directorate Baghdad, Iraq.
Corresponding Author: **Sarah A. Abed**, E mail: **sarahalabasy@yahoo.com.**

following scaling and root planing (SRP) in NSPT. Among the materials studied are dentinal tubule obliterators, such as toothpaste [6,7] and varnishes [8,9] and neural desensitizing agents, such as gels containing potassium nitrate combined with sodium fluoride.[10] Furthermore, investigations on the effects of lasers on DH have revealed promising results. [6,8]

Pamir et al, in 2005 applied different kinds of desensitizing agents on one hundred teeth with dentine hypersensitivity in 28 patients, they found that desensitizing agents were similar to each other effective in reducing moderate dentine hypersensitivity,[11] another study done by Erdemir et al, in 2010 on 131 teeth with dentine hypersensitivity on 11 patients using three different types of desensitizing agents found that all types of desensitizing agent were effective in reducing dentine hypersensitivity after one month independent on their application methods.[12]

Low-level laser therapy a highly safe and effective method for reducing dentine hypersensitivity as reviewed by et al, in 2015 Mirjana in twenty patients with eighty-two teeth with dentine hypersensitivity.[13] Another study achieved significant teeth desensitization after using 660 nm and 830 nm wavelength diode lasers in forty teeth with cervical exposure and dentine hypersensitivity.[14]

This study examined and compared the effects of a Riva star (SDI) desensitizing agent and low-level diode laser therapy on post-scaling dentine hypersensitivity.

METHODS

Study design and setting: a non-randomized controlled trial was conducted at Al-Shaikh Omar Specialized Dental Clinic/Al-Ressafa Health Directorate, Iraqi Ministry of Health and Uruk University in Baghdad, Iraq from 1 December 2022 to 1 December 2023.

Ethical consideration: The research ethics committee at Al-Ressafa Health Directorate approved the protocol of this study. According to the code of ethics in research adopted by the Ministry of Health in 2016, informed written consent was obtained from each participant before enrollment and after the study's aims and potential adverse events were explained. Participation in this study was voluntary, and the decision not to participate did not affect the care needed.

Inclusion and exclusion criteria: This study included a patient with dentine hypersensitivity due to cervical exposure developed after scaling and polishing to treat calculus build with at least a 2 mm gingival recession. Dentine hypersensitivity was diagnosed by pain induction by applying tactical or osmotic stimuli on the teeth. The pain was assessed using a visual analogue scale, and we included only patients who quantified the pain as six and above on this scale in this study. We excluded patients who were over 60 years old, smokers, pregnant, had fractured teeth, pulpitis or pulpal pathology, acute necrotizing ulcerative gingivitis (ANUG) and acute necrotizing ulcerative periodontitis (ANUP).

Sampling: The sample was selected conviniently from the patients visiting the dental clinics of Al-Shaikh Omar Specialized Dental Clinic and Uruk University in working days during the studied period.

Procedure: We allocated enrolled patients into three groups: the *positive control group* received no intervention; *Intervention group 1*, the exposed root surface, was treated with Riva star (SDI) tooth desensitizing agent, which is a silver fluoride and potassium iodide as an active ingredient. The gingiva was protected by i-block light cure liquid coffederm / block-out model resin. *Intervention Group 2*: the exposed root surface was treated with low-level laser therapy (quick lase QWLASER3-8(810nm)) (0.5W(0.25w+0.25w)) for 30 seconds in non-contact mode (0.5 mm away from the tooth surface.[15] Patients who quantified pain as below six on VAS were included in the fourth *Negative Control Group*. The negative control group was to eliminate the pain induced by the scaling process, not the post-scaling desensitization.

Because of technical facilities, the patients who attended Uruk University were allocated

Table 1 | Demographic distribution among studied groups.

Features	Positive control	Negative control	Desensitizing agent	Laser Group	Total	P-value
Mean age ± SD (years)	37.93±9.63	38.13±8.88	37.93±11.72	39.53±10.02	15	0.96
Age groups (years)						**0.89**
(20-29)	3 (20.0%)	4 (26.7%)	5 (33.3%)	3 (20.0%)	15 (25.0%)	
(30-39)	4 (26.7%)	4 (26.7%)	2 (13.3%)	4 (26.7%)	14 (23.3%)	
(40-49)	**6 (40.0%)**	**6 (40.0%)**	**4 (26.7%)**	**6 (40.0%)**	**22 (36.7%)**	
(50-58)	2 (13.3%)	1 (6.7%)	4 (26.7%)	2 (13.3%)	9 (15.0%)	
Sex						0.7
Male	10 (66.7%)	10 (66.7%)	8 (53.3%)	8 (53.3%)	36 (60.0%)	
Female	5 (33.3%)	5 (33.3%)	7 (46.7%)	7 (46.7%)	24 (40.0%)	
Total	15 (100)	15 (100)	15(100)	15 (100)	60 (100)	

between the control and study group 1 according to patient desire. The patients who attended Al-Shaikh Omar Specialized Dental Clinic were distributed between control and study group 2 according to patient desire.

Outcomes: After two days, the patients were asked to evaluate the post-scaling dentine hypersensitivity using a visual analogue scale (VAS) in response to cold water stimuli from zero to ten, where zero represents "no pain" and ten represents the highest degree of pain. The outcome was measured by calculating the difference in pain scale before the application of the intervention and two days after that.

Statistical analysis: The data was analyzed using the IBM SPSS-22 statistical package (IBM Statistical Packages for Social Sciences- version 29, Chicago, IL, USA). The data were presented using basic statistical metrics such as frequency, percentage, mean, and standard deviation. The statistical significance of the dispersion between several means (quantitative data) was assessed by applying the student's t-test, which compares the difference between two independent means. The statistical significance of variations in distinct percentages (qualitative data) was assessed using the Pearson Chi-square test (X^2-test) or the Fisher Exact test. Statistical significance was determined by using a P value of 0.05 or less.

RESULTS

The results of this study observed a non-significant difference in the mean ages of studied groups, so all the age groups were at the third to fourth decade of age with (P-value=0.96) with This study's results showed a non-significant difference in the age range groups (Years) between the studied groups with (P-value=0.89) as well as no statistically

Table 2 | Distribution of the studied groups according to pain response to stimuli.

Pain Degree	Positive control	Negative control	Desensitizing agent	Laser Group	Total
0	3 (20.0%)	11 (73.3%)	8 (53.3%)	12 (80.0%)	34 (56.7%)
1	**0 (0.0%)**	**0 (0.0%)**	**2 (13.3%)**	**0 (0.0%)**	**2 (3.3%)**
2	1 (6.7%)	2 (13.3%)	0 (0.0%)	1 (6.7%)	4 (6.7%)
3	2 (13.3%)	1 (6.7%)	0 (0.0%)	1 (6.7%)	4 (6.7%)
4	**2 (13.3%)**	**0 (0.0%)**	**1 (6.7%)**	**0 (0.0%)**	**3 (5.0%)**
5	4 (26.7%)	1 (6.7%)	0 (0.0%)	1 (6.7%)	6 (10.0%)
6	2 (13.3%)	0 (0.0%)	3 (20.0%)	0 (0.0%)	5 8(.3%)
7	1 (6.7%)	0 ()0.0%	1 (6.7%)	0 (0.0%)	2 (3.3%)
Total	15 (100.0%)	15 (100.0%)	15 (100.0%)	15 (100.0%)	60 (100.0%)
Mean	3.7	0.8	2.06	0.6	
P-value			0.01		

Table 3 | Distribution of Positive Control and desensitizing agent groups according to the degree of Pain response to stimuli.

Pain Degree	Positive control	Desensitizing agent	Total
0	3 (20.0%)	8 (53.3%)	11 (36.7%)
1	**0 (0.0%)**	**2 (13.3%)**	**2 (6.7%)**
2	1 (6.7%)	0 (0.0%)	1 (3.3%)
3	2 (13.3%)	0 (0.0%)	2 (6.7%)
4	**2 (13.3%)**	**1 (6.7%)**	**3 (10.0%)**
5	4 (26.7%)	0 (0.0%)	4 (13.3%)
6	2 (13.3%)	3 (20.0%)	5 (16.7%)
7	1 (6.7%)	1 (6.7%)	2 (6.7%)
Total	15 (100.0%)	15 (100.0%)	30 (100%)
Mean	3.7	0.8	2.06
P-value		0.03	

Table 4 | Distribution of positive control and laser group according to the degree of pain response to stimuli.

Pain Degree	Positive control	Laser group	Total
0	3 (20.0%)	12 (80.0%)	15 (50.0%)
1	**0 (0.00%)**	**0 (0.00%)**	**0 (0.00%)**
2	1 (6.7%)	1 (6.7%)	2 (6.7%)
3	2 (13.3%)	1 (6.7%)	3 (10.0%)
4	**2 (13.3%)**	**0 (0.0%)**	**2 (6.7%)**
5	4 (26.7%)	1 (6.7%)	5 (16.7%)
6	2 (13.3%)	0(0.0%)	2 (6.7%)
7	1 (6.7%)	0 (0.0%)	1 (3.3%)
Total	15 (100.0%)	15 (100.0%)	30 (100.0%)
Mean	3.7	0.8	2.06
P-value		0.02	

significant difference in the number and percentages of gender between the studied groups (P-value=0.7) as arranged in Table 1.

This study showed that 12/15 (80.0%) of participants treated with laser hadn't any pain postoperatively, followed by 11/15 (73.3%) of negative control had a negative response. In contrast, the groups with desensitizing agent showed 8/15 (53.3%) cases with no pain response, and only 3/15 (20.0%) among positive control groups showed no response to pain; the results also documented only 4/15 (26.7%) of positive control groups showed pain degree with a score 5, while the groups whose treated with desensitizing agent showed pain with six scores 3/15 (20.0%), other degrees of pains from 1, 4 and 7 scores among all the studied groups showed equal cases ranging from 0, 1 and 2 respectively from total study cases 15 cases, These differences were statistically significant, with a p-value of 0.01, see Table 2.

Table 5 | Distribution of Desensitizing agent and Laser groups according to the degree of pain response to stimuli.

Pain Degree	Desensitizing group	Laser group	Total
0	8 (53.3%)	12 (80.0%)	20 (66.7%)
1	**2 (13.3%)**	**0 (0.0%)**	**2 (6.7%)**
2	0 (0.0%)	1 (6.7%)	1 (3.3%)
3	0 (0.0%)	1 (6.7%)	1 (3.3%)
4	**1 (6.7%)**	**0 (0.0%)**	**1 (3.3%)**
5	0 (0.0%)	1 (6.7%)	1 (3.3%)
6	3 (20.0%)	0 (0.0%)	3 (10.0%)
7	1(6.7%)	0 (0.0%)	1 (3.3%)
Total	15 (100%)	15 (100%)	30 (100%)
Mean			
P-value		0.04	

This study's findings demonstrated that there was a significant difference in pain response between positive control and desensitizing agent groups with a p-value of 0.03; for the positive control group, the cases distributed differently from (1 to 7) degrees with the highest number of patients report degree 5 pain response (5 patients) while the least number of patients feel degree 2 and 7 pain response (1 patient for both) while no patient feel degree 1 pain response, for desensitizing agents group, the highest number of patients report degree no pain response to stimuli (8 patients) while no patient feel degree 2,3, or 5 pain response, Table 3.

The findings of this study revealed a significant difference in pain response between the positive control and laser groups, with a p-value of (0.02) for the positive control group, the cases distributed differently from (1 to 7) degrees with the highest number of patients report degree 5 pain response (5 patients) while the least number of patients feel degree 2 and 7 pain response (1 patient for both) while no patient feel degree 1 pain response, for laser group, the highest number of patients report degree no pain response to stimuli (12 patients) while no patient feel degree 1,4,6 or 7 pain response, See Table 4.

The results of this study demonstrated a significant difference in pain response between the desensitizing agent group and laser groups with a p-value (0.04), with the distribution of

cases as discussed previously, See Table 5.

DISCUSSION

Dentin hypersensitivity (DH) develops once the protective cement or smear layers covering the underlying dentin are removed, with acid erosion having a crucial role in exposing dentinal tubules.[16] A thorough examination undertaken by Draenert et al. in 2013[17] revealed that the degradation of dental tissue is linked to multiple factors, including gingival recession, periodontal surgical interventions, NSPT including SRP, and often a combination of these procedures. This study postulates that desensitizing drugs and laser therapy can be supplementary measures to non-surgical periodontal care to avoid or minimize the likelihood of post-scaling dentin hypersensitivity.

The current analysis demonstrated that although DH following non-surgical periodontal therapy is temporary, desensitizers play a crucial role in providing pain relief to patients.[18] Various studies demonstrated the efficiency of desensitizing agents occluded to the opened dentinal tubules or by a neural mechanism in treating dentine hypersensitivity.[11,12,13]

The diamine silver fluoride/potassium iodide preparations contain many components that may have contributed to this investigation's notable decrease in dentine hypersensitivity. Silver ions can cause proteins to form solid particles in the small channels within the tooth's dentin, and they have been widely employed for a significant period as a substance that reduces tooth sensitivity.[19] Fluoride ions can undergo a chemical reaction with unbound calcium ions, forming calcium fluoride deposits. These deposits have the potential to obstruct dentinal tubules.[20]

Furthermore, the creation of silver iodide from the interaction of diamine silver fluoride and potassium iodide could have contributed to a further decrease in dentine tubule patency.[21] These mechanisms may account for the significant discrepancies between the control and desensitizing agent groups. Similar result reported by Craig etal, in 2012.[14]

When examined, both high and low-power lasers exhibited the capacity to decrease DH in both the short and long term. The laser beam's heat obliterates the dentinal tubules, preventing the transmission of stimuli and inhibiting the passage of fluids within them, resulting in an omission of pain.[22] This result was in accordance with ELmobadder etal in 2012.[15]

Recently, diode lasers have become the most commonly employed by dentists in their daily practice. Numerous studies have been conducted on this specific type of laser, specifically focusing on its advantageous benefits against DH, which can be found in the literature.[23,24]

CONCLUSION

In the scope of this study, authors notified that using a diode laser was a less time-consuming, easier procedure with no post-operative discomfort or complication reported by the participants, which appeared to be superior to using desensitizing agents that experienced longer time as the process had more than one step in addition to adding the gingival protector with two unwanted adverse reactions of gingival erythema, for further investigations to the comparisons between these two procedures.

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Abbreviations list: Acute necrotizing ulcerative gingivitis (ANUG), Acute necrotizing ulcerative periodontitis (ANUP), Dentin hypersensitivity (DH), Non-surgical periodontal treatment (NSPT), Scaling and root planning (SRP), Statistical Package for Social Sciences (SPSS).

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